RAILWAY ECONOMICS

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A TREATISE ON
THE PROBLEM OF HOW
TO
INCREASE THE EARNINGS
OF
FREIGHT EQUIPMENT

By F. S. INGOLDSBY

1901

Railway Economics.

. . . . . .

BROUGHT to first principles, the main object of a railroad company is to carry and deliver freight and passengers in a safe, economical and expeditious manner.

The best brains of mankind have been endeavoring to accomplish this seemingly simple result ever since the introduction of steam, yet the fact (especially pointed out in the leading article of the Railway Equipment Register, of December, 1900,) that "*equipment costing millions of dollars, built for the express purpose of carrying freight, moves two hours per car per day, and stands twenty-two hours per car per day*," clearly demonstrates that much remains to be done before this important problem is reduced to its lowest terms.

In the year 1900, there were 1,461,856 freight cars in use in the United States, Canada and Mexico, and as the average cost of old and new rolling stock was at least $500.00 per car, the total cost of this equipment was approximately $730,928,000, and as it stands idle twenty-two hours out of each twenty-four (equalling 91.6%) we have nearly $670,000,000 wastefully earning nothing and being slowly but surely lost by decay.

These facts naturally suggest the inquiry: Why do these costly cars stand idle over 90% of their lives?

Is it because there are more cars than is needed to carry the freight of the country? If so, the remedy is simple—buy less equipment.

But it is evidently not so, since almost all roads report shortage of cars, and shippers are continually clamoring for "empties."

Then what is the reason for this enormous loss to the railways of the country?

Here let an opinion be ventured, which, even if erroneous, will promote discussion and bring out the truth.

As the writer views it, the most potent cause for this trouble lies in the fact that for years the railroad companies have been allowing their patrons *to use cars as store houses.*

Even with the various Car Service Associations doing their best to keep equipment moving, coal is given from two to three days free time for unloading, while ore, grain, coke, broken stone, cotton seed, sand, etc., get about the same consideration, yet all this freight, comprising, as it does, about 50% of the total tonnage hauled, is of such a character that it is capable of being instantly unloaded from the cars and the latter freed for immediate service.

However, in order to accomplish this, there must be—

1st. Proper Terminals.

2nd. Comprehensive Traffic Rules Clearly Understood and Enforced.

3rd. Equipment Capable of Discharging its Load Instantly, Under All Conditions.

Does this sound like revolution?

Let us examine it.

Terminals.

THE cars now used as store houses (while being delayed at delivery points) cost from $15.00 to $25.00 per ton of storage capacity, and owing to the wear and tear of travel and the liability of wrecks, their lives are short compared to the life of any permanent terminal the cost of which is from $6.00 to $12.00 per ton of storage capacity; $11.22 being the average cost of such expensive terminals as those storage docks located at Duluth, Two Harbors, Escanaba, and other points on Lake Superior, which have a total storage capacity of 623,612 gross tons of ore, and which were constructed at a cost of about $7,000,000, as was noted by Arthur C. Johnson, C. E., in his memorable paper read before the Civil Engineers' Club of Cleveland in January, 1900.

Cost.

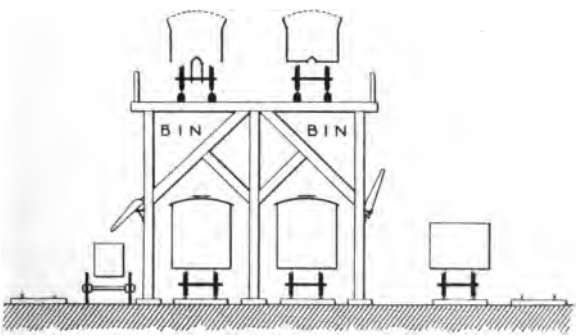
Saving and Advantage.

Therefore, would it not be the part of both wisdom and economy for the railway companies to spend less for rolling stock, car repairs and labor, and put a small portion of this saving into permanent terminals? Such structures certainly cost less and last longer than the movable store houses (the cars) which the roads are now furnishing their patrons, their cost of maintenance would be less than that for cars, and they would so facilitate traffic that much of the congestion now noticeable at all large shipping points would be relieved.

If properly built, they would do still more; they would practically double the yard room in places where each foot of space costs hundreds of dollars.

By being sufficiently elevated above the present yard levels, they would make the yards double decked, so to speak, with room

on top for the loaded cars to discharge their freight into the storage bins, and room underneath for classification tracks, departure tracks, or storage tracks, as the case might be.



A SKETCH OF SUGGESTED TERMINALS FOR RETAIL COAL DELIVERY IN LARGE CITIES.

To more clearly understand this point, examine the above.

Retail Coal Delivery.

It will be noted in this sketch that the lower tracks have been left as they exist to-day, and the storage bins, with their delivery tracks, have been simply placed

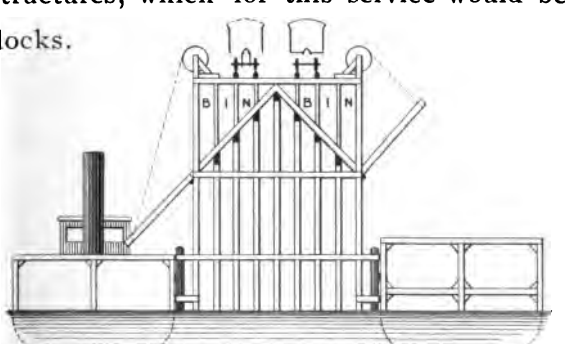
above them. One incline can lead to these elevated bin tracks, and its supporting posts can be so placed that they will not hamper the free movement of trains on the lower level.

Gain. With such terminal, the bins could be numbered, and each coal dealer could rent as many as his trade demanded; his wagons could be loaded promptly, and he would be saved all trouble and expense of unloading the cars or being taxed for demurrage, while the railroad companies would get, from the rentals, much more than the interest on their outlay, would release their cars for immediate service and would practically double their yard room.

Coal Breakage. Answering the objection that dumping bituminous coal would cause too much breakage, the reply is made that this can be

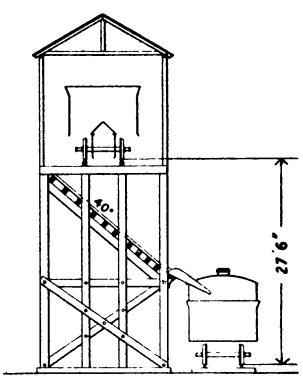
reduced to a minimum by properly designing the bins, and that this loss by breakage (not much, if any, greater than when coal is repeatedly shoveled, as under present system) is made up many times in the gains just noted.

Water Craft. For coal or ore delivery into water craft of any kind, practically the same character of bins shown in preceding sketch can be employed; the boats, barges or steamers taking the place of the wagons on either side of the structures, which for this service would be docks.



SKETCH OF STORAGE DOCKS FOR COAL OR ORE DELIVERY INTO WATER CRAFT.

Coaling Engines. For coaling engines out on the line, it is the almost universal practice to build the coal chutes in such a way that every pound of coal must be shoveled into the bins, whereas this constant labor-drain could all be avoided by constructing the chutes so the coal could be dumped from the cars directly into the bins.



SKETCH OF COALING CHUTE.

It is true that this would necessitate a few feet additional height to both the approaching trestle and the chutes, but the

additional cost would be so slight that the saving in labor would fully pay for it in a very short time.

The present system is to have the bins of these coaling chutes built to a size calculated to hold a given tonnage; the object being to keep a record of the amount of coal furnished each engine without the necessity of weighing it; but as the accuracy of this method depends entirely upon whether or not the bins have been filled to a greater or less extent than their capacity, large discrepancies, either one way or the other, invariably exist between the amount of coal recorded as having been purchased and that amount which is recorded as having been used by the engines; hence, such method of engine coaling is susceptible of great improvement in this particular.

Tenders Marked.

If the engine tenders had metal markers placed both horizontally and vertically on

the inside faces of the tank, whereby the coal tonnage contained in the tender could be easily read at a glance, it would be entirely unnecessary to have the coaling chutes divided into small bins as they are now, thus saving all the cost of such dividing partitions; and the tonnage of coal delivered to the tender from the chute could be much more accurately gauged than under the old system.

If two or more grades of coal were to be delivered from the same chute, as for instance, one grade for passenger engines and another for freight engines, the coaling chute could be divided into two large bins for the separate grades; but the record of the amount delivered to an engine would be read off from the engine tender, instead of from the bin.

The outlets of these chutes should be one

or the other of the many forms of cut-off gates, so the flow of coal into the tender could be stopped instantly at any stage of the proceeding, instead of being constructed, as they are now, in such a way that when once opened, the entire amount of coal behind them must of necessity go into the tender.

Grain Delivery.

In unloading grain from box cars, in which it must be carried to protect it from the weather, various methods, including air suction, have been employed, but the one now most in vogue is by means of power-operated shovels or scrapers.

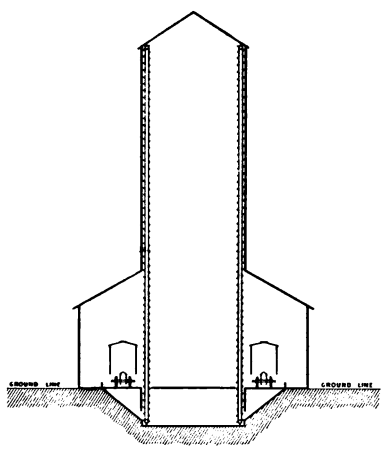
Two shovels are used for the unloading of each car, and the number of men required varies from two to four. The shovel men get from 20c. to 40c. per hour, according to local rates.

The power is furnished by the machinery

in the elevator, and all the men have to do is to guide the shovels and then sweep out from the car such grain as cannot be conveniently reached by the power devices. The grain is thrown into a small hopper, underneath and to one side of the track, which discharges on to a belt conveyer, or "leg," which carries the grain to the upper part of the elevator.

This method, with two shovel men, takes on an average about twenty minutes to unload a car holding 66,000 lbs. of wheat, and to place and unload two such cars an hour is considered fair work for the average Elevator "leg;" whereas, if dumping box cars are used and the "leg" hoppers are enlarged so each hopper is capable of holding a car load of grain, one man can unload 100,000 lbs. of grain in a few seconds, and all the expense of machinery and power can be saved; besides which, the theoretical capac-

ity of the belt conveyer will be more nearly attained (the actual capacity is now only about 50% of the theoretical) and the cars will be released for immediate service, thus saving time and money for both the Elevator Company and the railroads.



SKETCH OF GRAIN ELEVATOR, SHOWING DUMPING BOX CARS UNLOADING DIRECTLY INTO THE "LEG" HOPPERS.

Ore Delivery.

For the storage or easy unloading of ore, the majority of docks and plants are already equipped with some form of bin or

trestle more or less effective, but there are in many of them some or all of the following defects:

1st. The slope of the bin floor is so flat that much difficulty is encountered in getting out the ore.

Experience demonstrates that this slope should be at least 40 degrees from the horizontal.

The movable lip to a storage bin side-port, when fully let down, should have its angle of inclination less than 40 degrees (the slope of the bin floor), for the reason that such arrangement provides a proper check for the discharging material, and also lessens the height of the structure.

2nd. The delivery tracks are placed to one side of the storage bins, instead of directly above them, as they should be.

This is particularly noticeable at most plants erected throughout the West for the

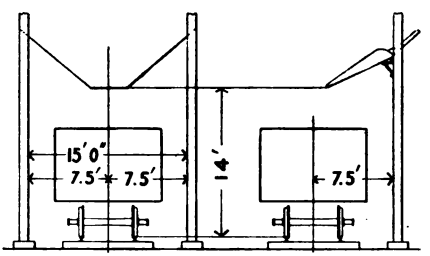
reduction of ores carrying the precious metals, and it is probably due to the fact that in the beginning almost all such ore was transported by means of wagons, which drove up alongside the building, and from which the ore was shoveled into the bins; but it is self-evident that it is practically impossible to load a bin to its full capacity by shoveling or dumping into it from one side only; whereas, if the delivering vehicle is standing directly over the bin, a much more complete filling of the latter is insured, whether the delivering vehicle be some form of dumping device or not.

3rd. The top openings of bins are unnecessarily contracted.

The top opening best suited to accommodate all kinds of cars should have a minimum width of 10 feet by a minimum length of 15 feet, and bin openings 12 feet wide by 30 feet long are still more serviceable.

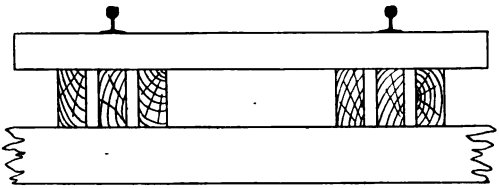
4th. The free height and width of structures with overhanging discharge ports are less than they should be to meet the demands of the increasing size of railway cars.

The result of observations on this point is the following suggestion for these dimensions:



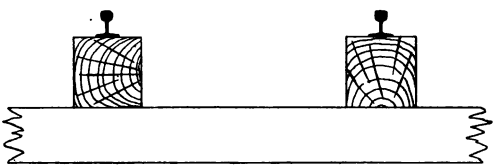
SAFE FREE HEIGHT AND WIDTH FOR OVERHANGING STRUCTURES.

5th. The track on top of storage bins or unloading trestles is laid on ties instead of being laid directly on the stringers, and only in rare instances, where it is laid on stringers, are the stringers and cross beams beveled, so as to present no horizontal surfaces for the lodgement of particles of the load.



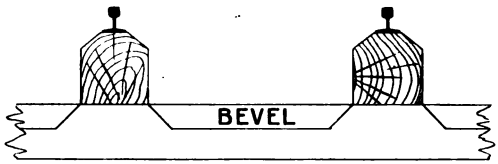
SKETCH OF DUMPING TRACK LAID ON TIES.

It seems almost useless to call attention to the above sketch to convince anyone that the ties prevent the free discharge of the loads, and necessitate much loss of time and labor to keep the track free from accumulated material.



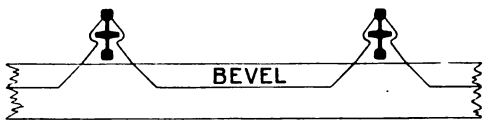
SKETCH OF USUAL FORM OF DUMPING TRACK LAID ON STRINGERS, WHICH REST ON FLAT CAPS.

In this second sketch it will be noted that the faces of the stringers and caps on either side of the rails are left flat, thus affording unnecessary lodging places for material which must be scraped off to avoid derailment of cars.



SKETCH OF DUMPING TRACK ON BEVELED STRINGERS, WHICH REST ON BEVELED CAPS.

The above arrangement prevents the lodgement of material on any parts of the structure, saves time, labor and attention, and avoids derailment.



SKETCH OF DUMPING TRACK, MADE OF FOUR RAILS.

By letting inverted rails take the place of the necessarily large wooden stringers, from 8 to 12 inches is saved in total height of the structure, and the rounded heads of the inverted rails give an easy and maximum clearance for large chunks of material.

The two rails are securely held in position by cast iron members, having appropriate slots for the reception of the rails. These

castings are securely spiked or bolted to the cap of the bent.

Beveled spacing members securely fastened to the rails and acting as strut-ties, are placed at proper intervals along the track between the points where the cast iron seats are located.

SKETCH OF DUMPING TRACK MADE OF FOUR RAILS AND SECURED TO STEEL I BEAM CAP, ON WHICH ARE FASTENED BEVEL CASTINGS.

This design for dumping track gives minimum height of structure, insures maximum life of same and is preferable to all other forms.

In-Takes. Intelligently designed in-takes for receiving raw products and fuel at Iron Furnaces, Smelters, Sampling Works, Stamp Mills, Chlorination Works, Sugar Factories,

Cotton-seed Oil Mills, Coke Ovens, Power Plants and the many other industrial works, would save millions of dollars annually, would facilitate the work, and would do for the slow and costly shovel that which electricity and auto-locomotion has done for the horse.

Transfer Points. For transferring bulk freight, such as coal, coke, etc., from one railroad car to another, from $1.50 to $2.00 per car could be saved in labor, and from 24 to 48 hours in time, if the roads had elevated tracks from which the loaded cars of one line could discharge their contents into the empty cars of the receiving road.

Summary. The foregoing only briefly treats of this important matter of terminals, but probably enough has been said to show that such structures have every advantage of cheapness in both first cost and maintenance; that

by their use the cars can go back into immediate service, that they save time and labor and relieve congestion at large shipping points, and that they can be made to increase the yard room; but in order to make them most effective, it is necessary to observe the following fundamental points in designing them:

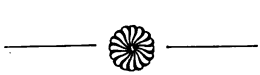
1st. Make the slope of bin floors sufficiently steep to insure complete discharge of contents.

2nd. Place the delivery track immediately over the bin.

3rd. Have the top openings large and free from obstructions.

4th. Give ample clearance everywhere.

5th. Save height by properly designing bin tracks and discharge ports.



Traffic Rules and Equipment.

TRAFFIC rules which, if followed, would result in the immediate unloading of bulk freight, such as coal, ore, grain, coke, broken stone, cotton seed, sand, etc., could not be enforced unless the railroad companies provided their patrons with equipment from which it would be easy to instantly unload the contents; hence, it is necessary to consider together the two factors, traffic rules and equipment, in the problem herein treated, namely, the problem of how to keep freight equipment in earning service more than 8 per cent of the time.

As noted on the fourth page of this book, freight cars now stand idle 91.6 per cent of their so called active life.

With proper terminals and equipment, the traffic rules governing the unloading of

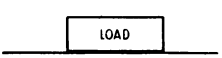
cars could be very simple in nature and easily enforced, and can be broadly summed up in the general provision that all car loads of dumpable bulk products must be unloaded within one hour from the time said cars are delivered to the consignee.

General Provision.

But now comes the question, what form of equipment will make possible the enforcement of such a rule?

First Principles.

If underneath any load there is a rigid horizontal plane, thus:

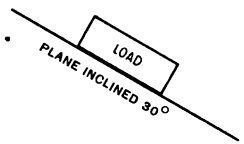


PLANE HORIZONTAL.

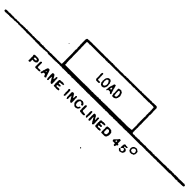
there is required the maximum amount of either manual or mechanical labor, and consequently the maximum amount of time, to remove it.

This time and labor of removal becomes

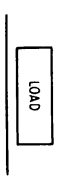
less, if underneath the load there is a slightly inclined plane, thus:



and this time and labor is still farther reduced by increasing the angle of the inclined plane, thus:



but absolutely *no appreciable time or labor is required* to remove the load, if it has a vertical, unimpeded drop, thus:



PLANE VERTICAL.

and it is evident that the larger an opening

is, the quicker will any given quantity of material be discharged through it; hence, in the study of railway dumping equipment, it is important to consider:

Important Considerations.

1st. The angles of the sloping ends or other inclined surfaces, and

2nd. The size and character of the openings through which the material is to be discharged.

Theories.

Theoretically, various materials, such as coal, ore, sand, etc., should run easily on slopes, which practical experience is daily demonstrating to be too flat; the reason being that theory does not take into account the compacting of the loads due to moisture, and the fact that the finer particles of any load act as a matrix tending to solidify the mass and make it stick to the supporting bottom.

Theories must of necessity be based on given conditions and given materials, whereas, railway dump cars have to meet all the conditions of sunshine or rain, heating or freezing, large chunks or fine particles, and everything else incident to the service, and the materials carried, comprehend a wide variety of products.

It would take but flat slopes and small openings in a car to quickly unload perfectly dry sand, but let that sand get wet, by rain, for instance, and practically every pound of it would have to be shoveled from such a car.

Limitations. No doubt, the very first builders of dumping cars realized the great importance of providing steep slopes and large openings, but the many limitations which have to be met in car construction made the problem of how to secure these desirable features without sacrificing others almost

as important, seem impossible of solution, and the consequence is that the majority of dumping cars now used only dump when the conditions are all favorable.

Classification. Classifying the best known forms of dumping cars, we have

1st. The side dump cars.

2nd. The "Hopper Bottom" cars.

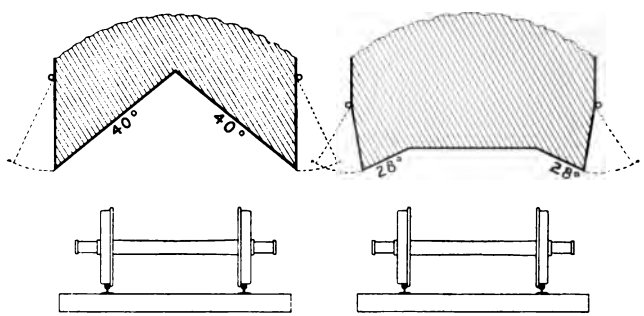
3rd. The center dump cars.

4th. The combination side-and-bottom dump cars.

And added to this list should probably be the gondola cars with hinged sides, which are not in reality dump cars, but from which the material can be scraped with a plow; but as this operation is attended with more or less breakage to the sides of the cars, and requires the machinery of plow, cable, etc., such cars can hardly be classed as dumping equipment.

Side Dump Cars.

In the best known forms of side dump cars, while the openings are, as a rule, of sufficient size, the slopes on which the material is expected to run are so flat that only part of the load is discharged, and the balance must be shoveled or pushed out of the car by manual labor.



THE "A" DUMP CAR. THE TRUNCATED "A" DUMP CAR.

CROSS SECTIONS OF SIDE DUMP CARS.

Increasing the slopes of such cars makes a corresponding decrease in their carrying capacity, as may be seen by looking at the cross sections.

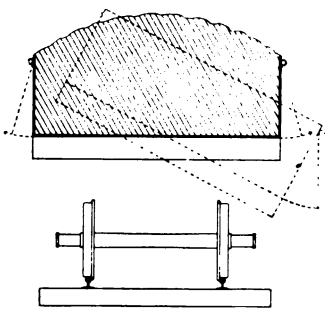
The "A" dump car is much easier to unload than the "Truncated A" dump car, because it has no flat surface for the lodgement of material, but its extremely small carrying capacity makes it of very little value.

The large area of *immovable* flat surface in the "Truncated A" dump car, forms a lodging place for a considerable proportion of the load, and this undumped material must be all removed by hand. In the case of frozen or compacted loads picks, shovels, or both of these and expensive thawing-out processes as well, must be resorted to in order to unload such cars.

Another type of side dump car which has been repeatedly tried, is the tilting car with hinged sides.

When in dumping position, the maximum angle of inclination of any tilting car is governed by the height of the pivotal point

above the top of the rail, the width of the car and the position of the stops (generally some point on the trucks) against which the bottom of the car finally rests, and as all these points are fixed within narrow limits in car construction, the usual angle for cars of this class is not much over 30 degrees, although greater angles have been attempted in some cases.



CROSS SECTION OF TILTING DUMP CAR.

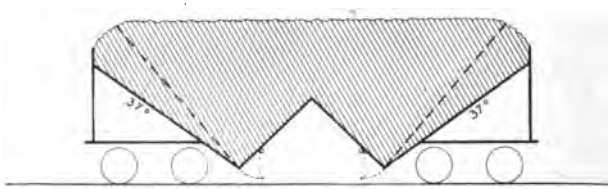
The operation of dumping changes the position of the center of gravity of such

cars, and if the load fails to discharge freely, and for any reason sticks in the car, the momentum carries this center of gravity outside the base, and the overturning of both load and car results.

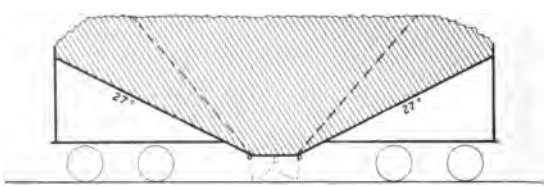
Hopper Bottom Cars.

The style of dump car which prevails more than any other is the "Hopper Bottom" car of either the single or double hopper bottom type. A large number of these cars have the slopes only at the hoppers, but as such cars only dump a very small proportion of their loads, and are simply intended to make the shoveling of the remaining contents less laborious, they need not be considered in the problem under discussion, but the hopper bottom cars which are intended to be self unloaders, not only have flat slopes, but small openings as well, and their only claim to consideration is that they carry somewhat larger loads than the

side dumpers just described, and are comparatively cheap to construct.



DOUBLE HOPPER BOTTOM CAR.



SINGLE HOPPER BOTTOM CAR.

LONGITUDINAL SECTIONS OF HOPPER BOTTOM CARS WITH SLOPING ENDS.

It will be apparent at a glance that in both forms of hopper bottom cars, shown in section, the fundamental principle of unloading is equivalent to attempting to force bulk material through the small end of a funnel, the load tending to choke itself in its effort to reach the opening; and as the openings

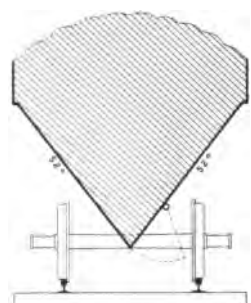
are always underneath the car and very close to the top of the rail, the choked load must be attacked from above in order to loosen it, and this mode of attack is always wasteful of time and labor. If there are any large chunks in the load the difficulties are increased. If the load is frozen, it must first be thawed out.

Even when loaded with slack coal, finely crushed ore, or similar free running material, a large proportion of such loads, if even slightly damp or compacted, remains in such cars (as shown by dotted lines on the cross sections) and has to be pushed or shoveled out by hand.

As these cars have no flat bottom, it is, of course, impossible to successfully use them for carrying lumber or similar freight, and they are not suitable for ballast spreading, bank widening, or other maintenance of way work.

Center Dump Cars.

True center dumping cars must, of necessity, have sides and ends either permanently or movably sloping inward towards the bottom, and the opening must be wholly underneath the car.



CROSS SECTION OF CENTER DUMP CAR.

Above is the cross section of the best form of true center dump car known to the writer, and where center dumping is absolutely demanded it is hard to improve upon this type, but like in the hopper bottom cars the principle underlying the discharge is the same

as in trying to force matter through the small end of a funnel, and the tendency to choke is ever present.

It is only necessary to look at the cross section to understand the main features about unloading cars of this class, when the loads have become compacted or frozen in them.

In ballast spreading, center dump cars when improperly handled, are liable to derailments, owing to excess material piling up in the center of the track and spreading to the rails; but if the track has been carefully prepared beforehand, and the cars are properly handled, the spreading of ballast is made very satisfactory and economical by their use.

Opinions are divided as to the best method of distributing ballast; a great number of experienced and efficient engineers and contractors holding that the only proper place

to deposit the ballast is alongside the track and just outside the rails; while others contend that the proper place to put the material is in the center of the track.

As near as the writer can gather from inquiries and observations extending over a number of years, the main argument in favor of center dumping is that where the banks have been worn away, very little of the ballast becomes lost or wasted; but those who prefer the side distribution of ballast claim, with apparent justice, that the first requisite of such a road-bed, is to widen it so the crown of the embankment will have its full and proper width, and then distribute the ballast alongside the track where it will be out of the way of the regular passenger and freight trains, and from where it can be easily handled by either inverted "V" plows or the regular section gangs, as the case may demand.

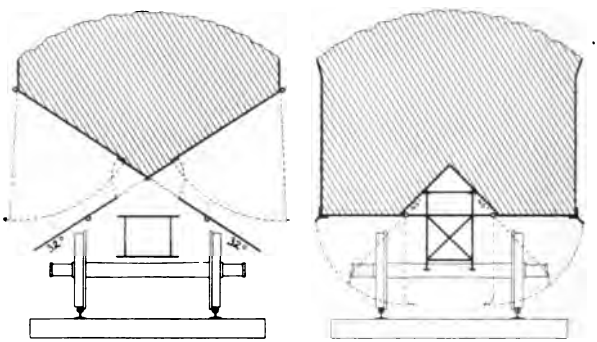
The absence of any flat bottom in center dump cars, as in the hopper bottom cars with sloping ends, makes their loading with lumber or similar freight impractical, and their use has been largely confined to ballast spreading, which service only slightly affects the problem of how to keep freight equipment in earning service more than the two hours per day which is its average under present conditions.

Combination Side-and-Bottom Dump Cars.

In the combination side-and-bottom dump cars—some form of which is destined to solve the problem presented herein—there are two types on the market differing widely in shape and design, as may be readily seen by the cross sections shown on the next page.

Both of these cars have large and ample openings.

The slopes in No. 1 have a minimum angle of 32 degrees from the horizontal, while the minimum slopes in No. 2 are 45 degrees from the horizontal.



NO. 1. NO. 2.

CROSS SECTIONS OF SIDE-AND-BOTTOM DUMP CARS.

In No. 1 the slopes for side dumping are fixed, while in No. 2 they are movable and adjustable to suit conditions, but in both cars a large portion of the load has an unimpeded vertical drop before striking against the slope which deflects it to the side of the track.

No. 1 has no flat bottom.

No. 2 has about two-thirds of its bottom flat.

The approximate centers of gravity of the two cars can be seen by a glance at the cross sections.

For cars of similar lengths, heights and widths, No. 2 has the greater cubic capacity, but this excess is not fully as great as the foregoing cross sections indicate, owing to the fact that the ends of No. 1 are vertical and close to the end sills of the car, whereas, the ends of No. 2 slope at an angle of 50 degrees from the horizontal and terminate at points above and slightly beyond the bolsters.

No. 1 is cut in two sections by a central cross partition, while No. 2 is open from end to end.

Both cars dump by either hand power or air power, both may be dumped while at

speed or at rest, and both can be built of wood or structural steel shapes and plates.

When these cars (having same general dimensions) are used as one-side dumpers, No. 1 can dump all of its load to either side of the track, providing the material will run on a 32 degree slope, while No. 2 can dump to either side of the track more of such material than No. 1, but such amount will not be its entire load.

Compacted or partially frozen loads discharge easily from each style of car, and the loads in either can be attacked from the bottom in the event of being frozen solid, but this work is somewhat easier in No. 2 than in No. 1 owing to the position of the doors when opened and the direction given the discharging material.

Constructed of steel, the ratio of dead weight to paying freight in No. 1 is about 53 per cent, and in No. 2 it is about 35 per cent.

Both cars are efficient in ballast spreading, bank widening, trestle filling, and other maintenance of way work.

No. 2 can be either an open gondola as shown, or a box car capable of carrying all kinds of freight.

In the matters of the operating mechanism, the general design, the details of construction, and the cost of these cars, and the others shown herein, the reader, for information, must look to the respective companies owning and marketing them; but as before stated, some form of combination side-and-bottom dump car operated in connection with proper terminals, will, in the writer's opinion, soon solve the problem of how to keep freight equipment in practically continuous earning service, and forever put a stop to most of the enormous waste of time and money noted in the beginning of this book.

Solution of the Problem.

THE END.

No. 1.

The Ingoldsby Patent Dump Cars used as Side Dumpers widening banks on the Louisville & Nashville R. R. near Anniston, Ala. Train moving at full speed, and rear car operated by the engineer in his cab, starting to distribute its 85,000 pounds load of slag.

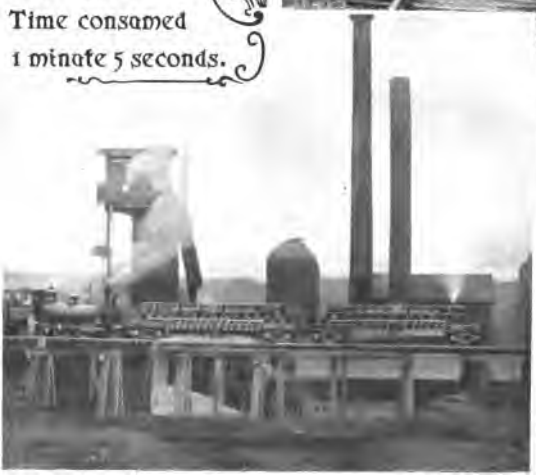
THE INGOLDSBY PATENT DUMP CAR

. . . . . .

IN the foregoing pages an effort has been made to frankly present without favor or prejudice, the salient features proven by experience to characterize the various forms of the most widely known dumping equipment, so those interested in railway service could study the different types and reach their own conclusions regarding the practical utility of each; but now that has been done, it is the purpose of the following pages to present in detail the advantages of one particular car; but as it bears the same name as the writer, anyone continuing to read to the end can not be blamed for believing parts of the description to be favorably prejudiced, and in the mind of such a reader there will, perhaps, exist grave doubts about some of the statements which will be made, therefore,

No. 2. Taken three seconds after No. 1, and showing the dust from the discharging load.

No. 3. Material deposited on each side of the track and the train backing up for other loads. Time consumed 1 minute 5 seconds.



160,000 pounds of limestone unloaded in 30 seconds.

such a seeker for the truth is earnestly and respectfully asked to

Go to the car itself, and resolve his doubts while inspecting its construction and its work.

Or, if he prefers to first digest the testimony of others, let him read the following:

LOUISVILLE & NASHVILLE R. R. COMPANY.
ALABAMA MINERAL DIVISION.
OFFICE OF THE SUPERINTENDENT.

ANNISTON, ALA., October 12, 1899.

MR. F. S. INGOLDSBY,
Chemical Building, St. Louis, Mo.

DEAR SIR—Referring to your favor of October 9th, we beg to advise that the Ingoldsby Automatic Car, No. 200, is being used in our slag service between Anniston and several points on our line, including some sections of our Anniston yard. In every case so far, and I see no reason why there should be any change, the contents of the car can be dumped in one place, if there is elevation enough to spread the load, or if it is on a trestle. If the ground is high on either side, we find that we can set the chains at the desired angle, and dump the car while in motion, dumping the contents evenly on one or both sides of the track. We find the car safe and easy to operate, either by hand or air, and it is by far the best side dump for road work I have ever seen. For ore, coal, limestone and other raw materials of that nature, which are dumped from trestles and in stock houses, your car is the best and easiest handled, to my mind, I have ever seen.

In our service we have had the car unloaded several times by men who knew nothing whatever about the

THE INGOLDSBY PATENT DUMP CARS IN COAL SERVICE ON THE CRYSTAL RIVER RAILROAD, COLORADO.

car, and in each case with entire success so far as the car was concerned. In one instance, one of our foremen fastened the chains at an angle of 45 degrees and dumped the car standing still; it emptied the whole load in one place, and he had to shovel the contents away from the doors before the car could be moved; this, however, was his own carelessness and no fault of the car.

Yours truly,

(Signed) W. E. KNOX,

Superintendent.

THE CRYSTAL RIVER RAILROAD COMPANY.
DENVER, COLO.

J. A. KEBLER, Vice-President and General Manager.

March 20, 1901.

F. S. INGOLDSBY, ESQ.,

Vice-President and General Manager The Ingoldsby Automatic Car Company, St. Louis, Mo.

DEAR SIR:—Regarding the 40 Ingoldsby narrow gauge cars which were delivered to us last September: We have tried these cars in every possible way, and under the most severe conditions which we can find. Twenty of them were for some time in use by The Denver & Rio Grande Railway in ore trade between the Orient mine and the steel works. The ore comes in large chunks, and was unloaded on a trestle at Bessemer. These cars were operated over 4½% grades and 20 degree curves. We have had absolutely no repairs of any kind on any of these cars, and have had no trouble whatever in dumping them.

The most severe test, however, was on the 20 cars which we are using on our own railroad, which runs to the summit of the Rocky Mountains. We use them there to take coal from a coal mine, which we have been opening up, down to our coke ovens, twelve miles away. At the lower end they are dumped in a bin, and we have dumped eight cars in ten minutes, using only

the train crew to dump them, and without uncoupling from the engine.

This twelve miles of railroad is practically a continuous 4% grade, with frequent 40 degree curves, and one 50 degree curve. At the upper end we have the most severe winter weather, and have had over 7 feet of snow on a level. With the exception of two draw-bars, which were broken in letting the cars down, there have been no repairs whatever made to the cars, and they are satisfactory in every respect.

Sometimes, owing to heavy snows, snow has become mixed with the coal and the mass has frozen. In these cases, a few strokes with a bar has been sufficient to get out the frozen mass.

Yours very truly,

(Signed) J. A. KEBLER.

FROZEN LOADS OF COAL IN THE INGOLDSBY PATENT DUMP CARS.

As a demonstration of the great gains made by the use of the Ingoldsby Patent Dump Cars in the one matter of the transportation and delivery of coal, the following may be of interest:

Practical experience with all kinds of hopper bottom cars, proves that it costs from 10c to $1.25 per car to unload them from trestles; the cost varying according to whether the coal is lump or slack, whether labor is cheap or dear, and whether the material has been compacted by frost, rain, etc., and it is only under the most favorable conditions that a year's service with hopper bottom cars will show an average cost for unloading of less than 30c per car.

To this outlay for labor must be added the waste of time; as experience demonstrates that hopper bottom cars can in no instance be unloaded with sufficient rapidity to permit of the work being done without uncoupling from the engine.

In contrast to this, it will be noted that the report of General Manager J. A. Kebler

(printed on page 51), treating of winter service on the summit of the Rocky Mountains, says that the Ingoldsby Patent Dump Cars are so easily unloaded that the whole train is dumped *by the train crew;* and as this quick service makes it unnecessary to uncouple the engine from the train, all the cars go immediately back into paying service and no time is wasted.

The train crew mentioned in Mr. Kebler's report, consisted of two brakemen, and the condition of unloading, which had to be met, was the spotting of each individual car over a single bin; yet we find eight cars unloaded under these conditions in ten minutes, or four cars per man in ten minutes, which gives us one man's capacity equal to 192 cars per day, and as such labor can hardly command a higher wage than $2.00 per day, we have the cost of unloading an Ingoldsby Patent Dump Car practically demonstrated to be but a fraction more than one cent per car under the most severe conditions.

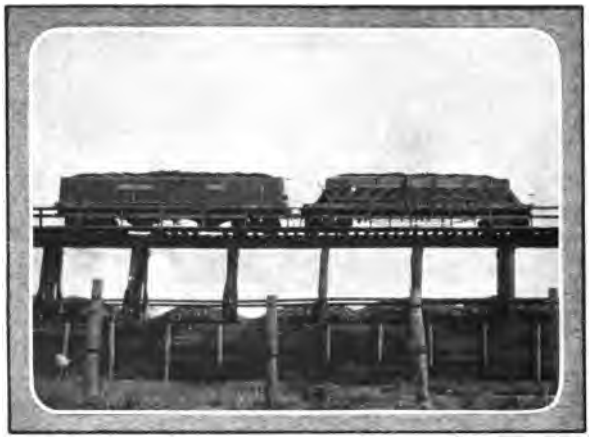
Now taking the cost of unloading hopper bottom cars at the average of say 30 cents per car, and the cost of unloading Ingoldsby Patent Dump Cars at one cent per car, we plainly have a saving in actual cost of unloading of 29 cents per car, to say nothing of the great saving of time, and the still more important fact that the *cars return at once to earning service.*

Reducing this to an example, we have, for say 1,000 unloadings per day:

$0.30=cost of unloading hopper bottom cars.
.01=cost of unloading Ingoldsby cars.
$0.29=gain per car.
1,000 unloadings.
$290.00 gain per day.
300 working days—
$87,000.00 gain per year.

which amount equals *5 per ct. on $1,740,000,* to which must be added the still greater items of *time-saving*, *reduced maintenance expense* and *reduced number of cars* for hauling a given tonnage, thus clearly putting the question,

Can any road afford to be without this equipment?



UNLOADING TEST.

In the above picture, taken in August, 1900, the car to the right is an old-style wooden Ingoldsby Patent Dump Car, and the car to the left, is a new hopper bottom car having sheet-iron covering over all slopes and improved hopper doors which offer no obstruction to the discharging load.

Both cars were loaded with easy running slack coal, and the loads were afterwards thoroughly saturated with water to show the effect of rain in compacting material. The ties under the openings of the hopper bottom car were removed from the track so the opening would be perfectly free. After shovels had been placed at each end of the H. B. car, so the two men engaged in the test would have no delay in getting them, one man was placed at each hopper with his bar set ready for opening, and then the word was given.

With all these precautions and with the men trying to do their best, it took the two men *3 minutes and 35 seconds* to unload the hopper bottom car, whereas, *one* of those now tired men without a moment's rest, stepped on to the platform of The Ingoldsby Patent Dump Car and unloaded its entire contents in *15 seconds*.

Comment is unnecessary.

ITEMIZED FACTS ABOUT

— THE —

INGOLDSBY PATENT DUMP CARS

They have *steep slopes* and *large openings.*

They have large *capacity* and light *weight.*

They completely dump their loads; the latter having a vertical unimpeded drop.

They go back into immediate earning service.

They can be used for almost any purpose for which an ordinary coal car can be used when dumping is not required.

They can be shoveled into or out of when necessary.

They spread ballast, widen banks or fill trestles rapidly and economically.

They can be dumped while train is in motion or at rest.

They carry all kinds of fine material without loss, as the *joints are tight.*

They easily discharge frozen or compacted loads.

They are *safe* and easy to operate.

In *side dumping,* the size of the openings and the slopes of the deflecting planes can be adjusted to suit the requirements of different materials.

One man can unload 100,000 pounds of coal, ore, grain, etc., in *ten seconds* by hand power.

THE INGOLDSBY PATENT DUMP CAR AS USED IN THE CLAY SERVICE AT AKRON, OHIO.

With the air dumping device any one car in the train, or the whole train can be unloaded *by the engineer in his cab*, whether under full headway or at rest.

Hand or air-dumping devices are independent of each other and can be worked separately or at the same time as desired, or the air device can be left off the cars and everything be worked by hand power.

Less than the whole load can be dumped; as one door—or one-half door, if the cars are so ordered—can be let down at a time, thus only discharging one-fourth (or even one-eighth) of the total load.

Their movable doors give a large, flat bottom area for "*loading both ways.*"

They are especially designed to *safely withstand wrecks without damage.*

Those portions of the ends of the cars which are outside and beyond the diagonal floor beams and bolsters can be smashed in or totally destroyed without affecting the balance of the car or its working, and in the event of loosened trucks ample protection is given to the car body by the inclined ends of the center trusses. In our steel construction the locking levers and all movable parts are amply protected by the overhanging members and main struts of the sides.

They have great strength and lasting qualities.

Special provision has been made against getting out of order.

The *center of gravity* of a loaded or empty car is close to the top of the rail.

These cars can be *locked* and *sealed* with ordinary car seals to prevent tampering over long hauls.

There are no loose parts about the mechanism.

OPERATING END OF THE INGOLDSBY PATENT DUMP CAR.

SHOWING HAND LEVERS, LOCKS, AIR DUMPING DEVICE, U TRUSSROD SADDLE, AND THE DOOR RAISING GEAR WITH SAFETY DISENGAGEMENT.

NOTE THE SIMPLICITY OF THE MECHANISM, AND THE SMALL SIZE OF SLOPING CENTER MEMBER COMPARED TO THE CROSS SECTION OF THE CAR.

THIS 77,000 POUND LOAD OF LIME ROCK WAS DUMPED ALONG THE TRACK WHILE THE TRAIN WAS MOVING AT THE RATE OF 40 MILES PER HOUR.

The "machinery" used on these cars is of the simplest possible nature, being mainly ordinary castings with practically no machine work required in fitting or erecting, and its entire function is to close the bottoms of the cars after dumping. Complete destruction of it would not put cars out of service, as the locking, holding and dumping of the bottoms is entirely independent. The use of this machinery is to make it easy for *one man* to close and lock a train of any number of cars *without a moment's delay, and with perfect* safety, while the train is in motion or at rest.

The false top (used only for carrying bulky freight) on either the wood or steel cars is easily removable in sections in the event of desiring to shovel into or out of a car.

A *small number of these cars* will haul and deliver a large tonnage in the shortest space of time, and they need never be idle.

They save *money, time and labor.*

KIND OF CAR.

The Ingoldsby Patent Dump Cars may be *gondolas or box cars.*

MATERIAL.

These cars may be all *steel*, or what is known as all *wood*, or they may be *part steel* and *part wood*.

Only commercial shapes and plates have been used in the design of the steel car, hence, material for its construction or repairs may be bought in the open market, and fashioned at cutters or forge.

WEIGHT.

The large 100,000 pounds capacity open steel cars equipped with proper trucks, are estimated to weigh 38,200 pounds, and when loaded with their service load, 110,000 pounds, the *ratio of dead weight to paying freight is only*

34.7 PER CENT.

Without any false top this ratio would only be

33 PER CENT.

The wooden cars are about 10 per cent. heavier than the steel cars of the same size, hence, the ratios of dead weight to paying freight in our wooden cars range from 37.6 per cent. for broad gauge, to 44.5 per cent. for narrow gauge cars.

CAPACITIES.

The possible heap on the steel cars having 16 inches of false top, equals

113,000 POUNDS OF COAL,

and such car with load crowned to 30 degree heap, equals

2,175 CUBIC FEET,

but for ore service or similar heavy freight, no false top is required.

In detail the capacities of the various cars are as follows:

BROAD GAUGE.

No. 1 Steel Car with 16 inch False Top.

Marked Capacity	100,000 pounds.
Service Load	110 000 pounds.
Possible Coal Heap	113,000 pounds.
Cubic Contents	2,175 cubic ft.

No. 1 Steel Car without False Top.

Marked Capacity	100,000 pounds.
Service Load	110,000 pounds.
Possible Coal Heap	86,600 pounds.
Cubic Contents	1,666 cubic ft.

No. 2 Steel Car with 16 inch False Top.

Marked Capacity	80,000 pounds.
Service Load	88,000 pounds.
Possible Coal Heap	~~88,500~~ 85,700 pounds.
Cubic Contents	1702. ~~1,648~~ cubic ft.

No. 2 Steel Car without False Top.

Marked Capacity	80,000 pounds.
Service Load	88,000 pounds.
Possible Coal Heap	67200. ~~65,000~~ pounds.
Cubic Contents	1292. ~~1,251~~ cubic ft.

No. 1 Wooden Car with 20 inch False Top.

Marked Capacity	100,000 pounds.
Service Load	110,000 pounds.
Possible Coal Heap	110600. ~~105,000~~ pounds.
Cubic Contents	2127. ~~2,022~~ cubic ft.

No. 1 Wooden Car without False Top.

Marked Capacity	100,000 pounds.
Service Load	110,000 pounds.
Possible Coal Heap	~~78,000~~ pounds.
Cubic Contents	~~1,502~~ cubic ft.

No. 2 Wooden Car with 16 inch False Top.

Marked Capacity	80,000 pounds.
Service Load	88,000 pounds.
Possible Coal Heap	87576. ~~77,000~~ pounds.
Cubic Contents	1683. ~~1,483~~ cubic ft.

No. 2 Wooden Car without False Top.

Marked Capacity	80,000 pounds.
Service Load	88,000 pounds.
Possible Coal Heap	63856. ~~58,300~~ pounds.
Cubic Contents	1228. ~~1,122~~ cubic ft.

NARROW GAUGE.

No. 3 Steel Car with 10 inch False Top.

Marked Capacity	50,000 pounds.
Service Load	55,000 pounds.
Possible Coal Heap	56,800 pounds.
Cubic Contents	1,094 cubic ft.

No. 3 Steel Car without False Top.

Marked Capacity	50,000 pounds.
Service Load	55,000 pounds.
Possible Coal Heap	47,000 pounds.
Cubic Contents	906 cubic ft.

No. 3 Wooden Car with 10 inch False Top.

Marked Capacity	50,000 pounds.
Service Load	55,000 pounds.
Possible Coal Heap	52,000 pounds.
Cubic Contents	1,000 cubic ft.

No. 3 Wooden Car without False Top.

Marked Capacity	50,000 pounds.
Service Load	55,000 pounds.
Possible Coal Heap	42,500 pounds.
Cubic Contents	821 cubic ft.

COST.

For hauling a given tonnage the cost of the Ingoldsby Patent Dump Cars is about the same as the cost of a sufficient equipment of good hopper bottom cars; for while the price per car is greater, *the number of cars required is less.*

MAINTENANCE.

This important item is naturally reduced; first, because there are not so many cars to oil, repair and keep in order, and second, because of the superior design and construction of these cars.

~~ADVANTAGES OF STEEL CONSTRUCTION~~.

While the Ingoldsby Patent Dump Cars can be built of either wood or steel, it is true economy to purchase steel cars for the following important reasons:

1st. Steel construction gives the largest capacity and the lightest weight, and these features are of such moment that they amply justify increased first cost. The railroad world at one time paid more than double price for such equipment.

2nd. The steel car has greater *ability to withstand wrecks without damage*, and experience has demonstrated that the cost of maintaining steel cars is practically nothing, whereas, the average cost for maintaining wooden cars is $10.00 per year; hence in the one matter of maintenance, a few years' service *would pay back the entire amount of the additional first cost.*

3rd. Building everything of steel permits the use of the very best form of *tight joints* for the dropping doors, and gives the best arrangement for preventing the lodgement of material on the inside edges of said doors when cars are being used as side dumpers.

4th. The center of gravity of the steel car is lower than the center of gravity of the wooden car.

5th. Steel cars may be loaded with hot ashes, slag, etc., without damage, whereas, wooden cars are liable to destruction from such loading.

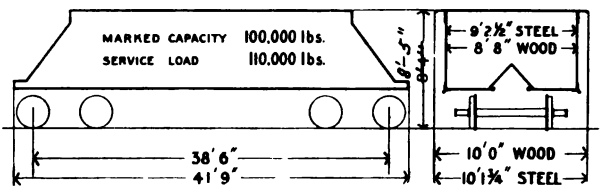
6th. When worn out, everything about a steel car has a market value as scrap, which is not true of wooden cars.

7th. Steel construction is up-to-date.

DIMENSIONS.

The important dimensions of our various cars are best shown by the following diagrams; the lengths are given from center to center of outside wheels, as well as total lengths over end sills, thus more clearly showing the proper length of scales to install for weighing purposes.

For coal or coke service, the false tops on these cars increase the distance from top of rail to top of car from 10 to 16 inches as per data given under heading of "Capacities," but these false tops are removable at will.



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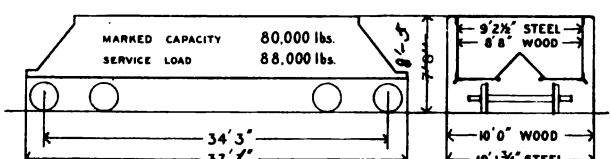

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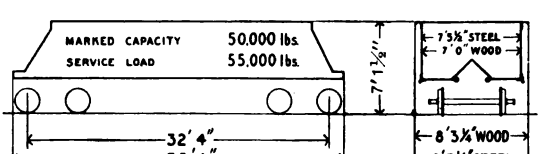

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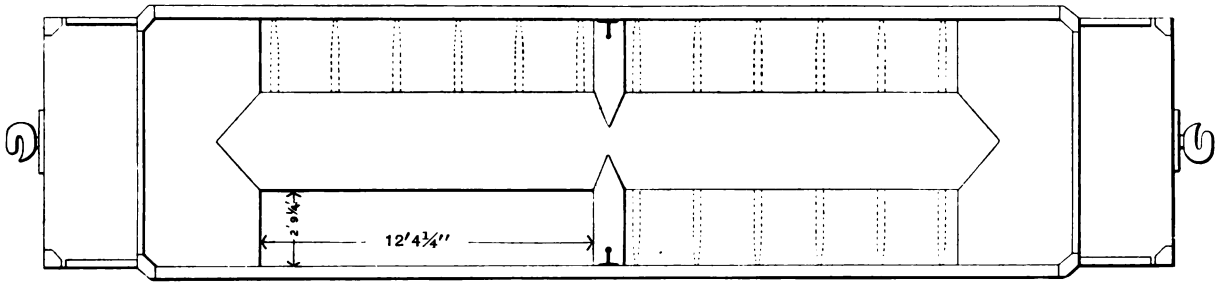
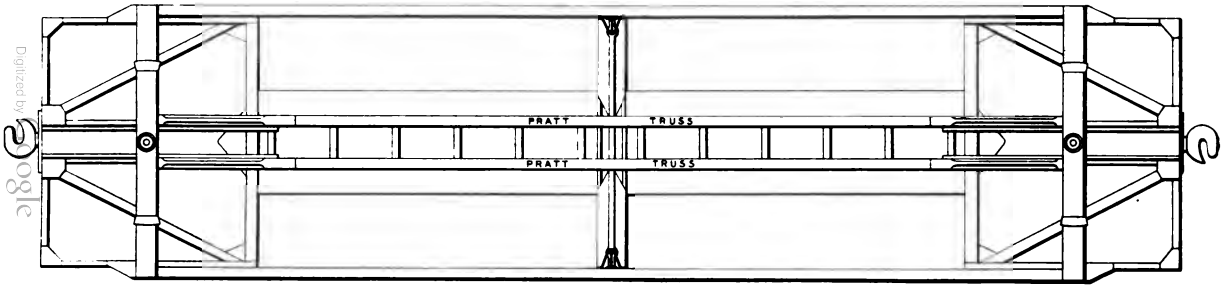
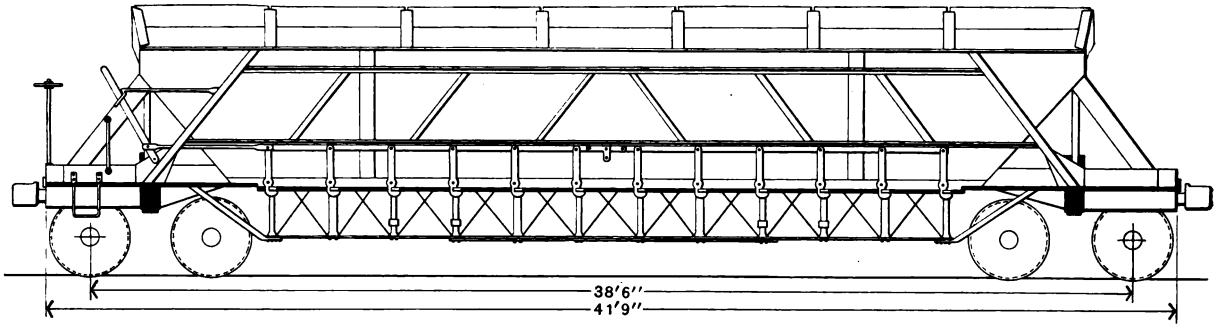


TOP VIEW, SHOWING ONLY ONE DOOR OPEN.



BOTTOM VIEW, SHOWING THE FLOOR SYSTEM.



SIDE ELEVATION.

THE INGOLDSBY AUTOMATIC CAR CO.'S PATENT OPEN DUMP CAR.

BUILT OF COMMERCIAL STEEL SHAPES.

THE CAR HERE SHOWN HAS A REMOVABLE 16 INCH FALSE TOP, AND WHEN THE LOAD IS CROWNED TO 30 DEGREE HEAP, IT HOLDS
113,000 POUNDS OF COAL.

LOADED WITH REGULAR SERVICE LOAD OF 110,000 POUNDS OF ANY MATERIAL, THE
RATIO OF DEAD WEIGHT TO PAYING FREIGHT IS
34.7 PER CENT.

THE CUBIC CONTENTS OF THIS CAR WHEN LOAD IS CROWNED TO A 30 DEGREE HEAP, IS
2,175 CUBIC FEET.

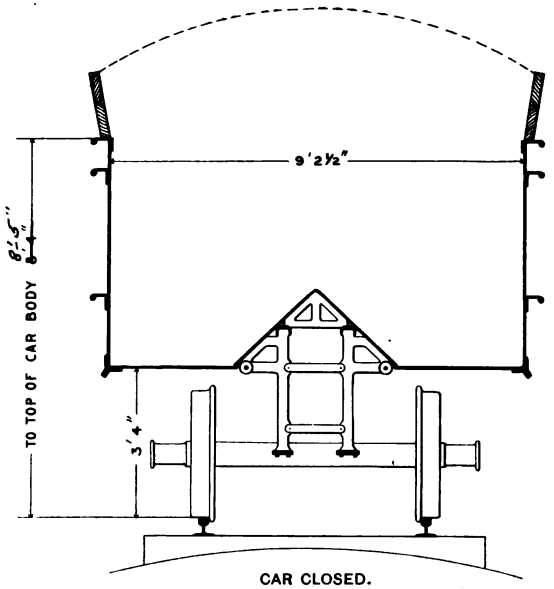
On the bottom view is shown the strong center member, which takes the direct strain resulting from the impact of head-on collisions or rough coupling, and also the diagonal struts, which not only tend to distribute this strain over the entire floor system, but which also protect the fundamental parts of the car in the event of wrecks.

Those portions of the ends of the car which are outside and beyond the diagonal floor beams and bolsters, could be smashed in or totally destroyed without affecting the working of the car.

In the event of breaking a king bolt, and the consequent loosening of the trucks from the car body proper, the upwardly inclined ends of the center trusses (shown on side elevation) tend to make the car body shoot up over the loosened trucks without damage; and even if these inclined members became bent or broken by the contact, they are short pieces which are easily repaired or replaced.

As shown on the TOP VIEW, the doors can be opened one at a time or all together, as desired.

For CROSS SECTIONS of this car in various positions see pages 68 and 69.



CAR CLOSED.

TIGHT JOINTS THROUGHOUT THE ENTIRE CAR.

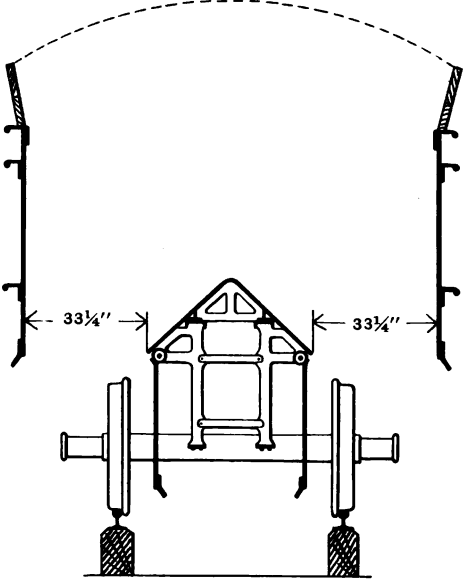
CROSS SECTIONS
OF
THE INGOLDSBY AUTOMATIC CAR CO'S PATENT OPEN DUMP CAR.
BUILT OF COMMERCIAL STEEL SHAPES.

FOR ELEVATION, TOP AND BOTTOM VIEWS, COAL CAPACITY, WEIGHT AND CUBIC CONTENTS, SEE PAGES 66 AND 67.

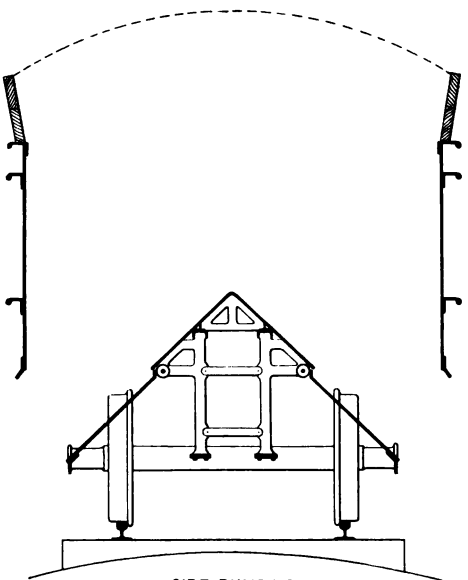
In the above cross section showing the car closed, particularly note the large area of flat bottom which permits of "loading both ways," and which affords ample standing room for men to shovel from the car in the event of such service being required.

In the BOTTOM DUMPING POSITION, note the large openings and the fact that the load has a vertical unimpeded drop, causing the immediate discharge of the entire contents of the car. This is usually the best position for the doors in unloading material into stock houses, storage bins, or from trestles.

In the SIDE DUMPING POSITION, which is the way the car is used for ballast spreading, bank widening and such service, note that the load has a vertical unimpeded drop before striking the inclined surfaces which deflect the material to the side of the track, and that the openings can be regulated to suit the requirements—i. e., for distributing a small quantity of material over a great distance, or a great quantity of material over a short distance.



BOTTOM DUMPING.
VERTICAL DROP THROUGH OPENING OF 137 SQ. FT.



SIDE DUMPING.
DOORS CAN BE HELD AT ANY ANGLE DESIRED.

As we hope and expect to have this little book read and discussed by all grades of railway workers, and as it might seem that our whole effort has been to argue in favor of decreasing the number of men required to handle the freight of the country, we believe that it will not be out of place for us to here give our conception of the true province of labor-saving devices.

While it is undoubtedly true that inventions of this character reduce to a minimum the number of men required to handle a given quantity of freight, it is likewise certain that this saving of labor so decreases the cost that the traffic of the railways is largely increased, and the number of men required to handle it is, therefore, maintained or augmented.

As a specific illustration of this point, we call attention to the millions of tons of ore already mined and lying idle on the dumps of our vast mineral sections, which are of too low a grade to ship without loss at the present rates of transportation, but a large proportion of which not only could be, but would be gladly given to the railroads to haul if there was a margin of profit of even a few cents per ton in the transaction; as all active mines are in need of as much dump room as they can get for the economical disposition of their waste product.

The handling of this enormous tonnage, which, under present conditions can not be handled, would give employment to an increased number of men, not only on the railroads, but at the mines and in the smelters or other reduction works; and an almost endless chain of activity, demanding the work of men, would be started for the benefit of both capital and labor and for the enrichment of the world.

Believing the above, and all contained between these covers, we hand this book to you and your friends with the compliments of

The Ingoldsby Automatic Car Company,

CHEMICAL BUILDING, ST. LOUIS.

PRESS OF
WOODWARD & TIERNAN PRINTING CO.,
ST. LOUIS.